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Worldwide Report

NUCLEAR DEVELOPMENT AND PROLIFERATION

No. 114

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LOK SABHA DISCUSSES NUCLEAR, DEFENSE PROBLEMS

Bombay THE TIMES OF INDIA in English 20 Aug 81 p 19

[Excerpts] The government is aware that the Bhabha Atomic Research Centre in Bombay, the Kota nuclear plant and Bombay High would come within the range of F-16 aircraft from Pakistani airfields, the minister of state for defence, Mr. Shivraj Patil, told the Lok Sabha today.

"The government is taking appropriate steps to meet the situation effectively", Mr. Patil told Mr. R. R. Bhole in a written reply. It was not in the interest of national security to disclose the details, the minister said.

Uranium offer: The minister of state for science and technology, Mr. C. P. N. Singh, said that India did not pursue the Soviet offer of enriched uranium because of its "existing agreement" with the U.S.

The offer was made in 1979 by the then Soviet Premier, Mr. Kosygin, during his visit to India.

Replying to another question, Mr. Singh said there were indications of uranium mineralisation in some areas of the Bastar district of Madhya Pradesh. No estimate of the reserves had yet been made. However, in the Bodal area of Rajnandgaon, reserves of about 2,000 tonnes had been estimated.

Libyan feeler denied: Mr. Singh denied a newspaper report that Libya had sought India's assistance in setting up a nuclear reactor.

N-plant site: The location of a nuclear power plant in the northern region will be considered after the site selection committee submits its report to the government, Mr. Singh said.

The minister told Mr. R. L. Bhatia that though Punjab had sought a nuclear power plant in its territory, it was for the site selection committee to choose the location of these plants.

He pointed out that the nuclear power development programme had to be integrated with hydel and thermal power programmes.

Reactors: Work on six nuclear reactors of 235 mw. each will be started during the sixth plan.

Of these, sanction has been issued for two reactors to be set up at Kakrapar near Surat at a cost of Rs. 382.52 crores, with a completion period of 125 months from the date of financial sanction.

A site selection committee has been set up to make recommendations for the other stations, Mr. C. P. N. Singh, minister of state for electronics, said.

Canadian uranium: Mr. C. P. N. Singh denied that India has made an arrangement with Canada for the supply of enriched uranium for fast-breeder reactors.

The minister assured Mr. M. V. Chandrashekhara Murthy that India had alternative measures for continued operation of the Tarapur atomic power plant, even if the United States stopped fuel supplies.

Liquid rockets: The government proposes to set up test facilities for liquid rockets at a location selected for the purpose in the Kanyakumari-Tirunelveli districts of Tamil Nadu, Mr. Singh said.

The project will be implemented after getting the necessary clearance, including that from the environmental angle, the minister told Mr. K. T. Kosalram in a written reply.

No serious threat has been posed by sea erosion to the Thumba rocket centre, Mr. Singh added.

CSO: 5100/7146

PARLIAMENT DISCUSSES TARAPUR PERFORMANCE, PACT

Calcutta THE STATESMAN in English 21 Aug 81 p 1

[Text] New Delhi, Aug. 20--Several Opposition members in the Rajya Sabha today pleaded for the abrogation of the 1963 agreement with the USA on the supply of enriched uranium in view of that country's failure to ensure continuous supply of the much-needed fuel for the Tarapur atomic power plant, reports PTI.

The Tarapur plant has been operating at 49% of its capacity because India had to stretch the available fuel, the Minister of State for Science and Technology, Mr C. P. N. Singh, told members during question hour. He said India was barred from reprocessing spent fuel or going in for alternative sources of enriched uranium so long as the agreement existed. But he assured the House that the Government was examining the possibility of using other types of fuel such as mixed oxide to keep the reactor going.

Mrs Gandhi told the House that the performance of the Tarapur plant in 1980-81 at 49% utilization was comparable to that of similar reactors in other parts of the world. She said in a written reply that except for the Tarapur plant, other atomic power plants in the country used indigenous nuclear fuel. However, development work on indigenous mixed oxide fuel for the Tarapur plant has been carried out and found feasible, she added.

In the Lok Sabha today, Mr P. V. Narasimha Rao, External Affairs Minister, said that the Government felt that nuclear cooperation with the USA should be handled bilaterally. He said that the U.S. nuclear policy declared in July this year did not affect the posture of the US Administration regarding the nuclear cooperation agreement reached between the two countries in 1963.

CSO: 5100/7148

AEC CHAIRMAN WRITES ON INDIA'S NUCLEAR POLICY

New Delhi PATRIOT in English 17 Aug 81 p 4

[Text]

INDIA is actively participating in international cooperative efforts to strengthen and streamline methods for safety and surveillance in nuclear power plants.

According to Atomic Energy Commission chairman H N Sethna, although India has not faced problems of public acceptance of nuclear power, there has been no question of complacency on the issue.

Physicists and radiation protection groups have already established stringent standards and norms to ensure against hazards to public health, Dr Sethna says in an article assessing India's nuclear policy, on the occasion of the Independence anniversary.

These safety standards will be an integral part of the projected power plants through which India hopes to take nuclear power generation from the current 1,300 MW to about 10,000 MW in the next two decades.

According to Dr Sethna, the design of the Narora nuclear plant is being standardised and will be repeated for two additional projects before India goes on to construct reactors of 500 MW based on totally indigenous design.

The Narora power plant, the fourth in the country consists of two 235 MW heavy water reactors. These reactors have several new design features and concepts, including earthquake resistant super-structures and reactor components.

The Narora reactors feature an integral calandria-and-shield assembly, two independent fast acting shut down systems for safety and reliability and a simplified water-filled calandria vault.

The third power plant, being built near Madras is approaching completion. According to Dr Sethna, the first of its 220 MW units is expected to attain criticality next year. The plant features many innovations to improve the economy and safety factors.

The atomic energy chief has defended the continuing development of natural uranium fuelled reactors in the country. India is one of the very few countries at present continuing with these types of reactors.

According to Dr Sethna, in formulating the strategy for nuclear development in India, the country had to take into account that while its uranium resources were rather modest (53,000 tonnes of which 30,000 tonnes are reasonably assured), the country had the largest thorium reserve in the world.

A three-stage nuclear fuel cycle strategy was therefore accepted. In the first phase were to be installed natural uranium reactors to be followed in the second stage by fast breeder reactor using the plutonium produced in the first stage together with the uranium-238 isotope or the abundant thorium. The eventual third phase will use the self-sustaining thorium with uranium-233 cycle.

Dr Sethna says that while the nuclear programme has been effected by "restrictive trade practices and unilateral embargoes on nuclear supplies by certain countries", in the long run they have helped strengthen and accelerate India's programme for complete self-sufficiency in the nuclear field.

In the development of the Tarapore, Kota and Madras plants, the import content has been progressively reduced. An additional benefit has been that Indian industry and technology has been helped to mature to the sophistication and quality control necessary in the nuclear age.

CSO: 5100/7145

RAJASTHAN HEAVY WATER PLANT LEAKAGE REVEALED

Bombay THE TIMES OF INDIA in English 20 Aug 81 p 1

[Text]

KOTA, August 19 (PTI): Two to three tonnes of heavy water have leaked out from the heavy water plant of the Rajasthan Atomic Power Plant (RAPP) unit I at Rawat Bhata, near Kota, on August 5, resulting in the shutting down of the unit, according to Mr. M. S. R. Sharma, officer incharge of the RAPP.

The leakage had occured owing to heavy fluctuations in the power supply, he told PTI here today.

Efforts were now on to resume power generation in the unit from tomorrow, he said. About 70 to 80 Mw of power would be generated initially once the unit went on stream.

Mr. Sharma said there was nothing to panic since the entire quantity of the leaked out heavy water had remained within the reactor and had not flowed into the nearby river or mixed with the atmosphere.

He denied that some employees working there suffered radiation. He said part of the leaked out heavy water had already been purified and pumped back into the heavy water unit and the remaining quantity was in the process of purification. This would be pumped back within this week, he said.

CSO: 5100/7146

BRIEFS

NUCLEAR PLANT SAFETY--Pending consideration of the creation of an Atomic Energy Regulatory Board, the existing Safety Review Committee (SRC), which presently regulates the safety aspects of all the nuclear establishments, has recently been reconstituted and its terms of reference revised, reports PTI. Prime Minister Indira Gandhi said in a written reply to Mr Jagdish Tytler that the reconstituted SRC has been given the task of carrying out the regulatory and safety functions envisaged for the Government by the Atomic Energy Act, 1962 to ensure safety of the operating personnel, members of the public and the environment. [Text] [New Delhi PATRIOT in English 10 Aug 81 p 7]

CSO: 5100/7147

U.S. MAY SUSPEND ENRICHED URANIUM SHIPMENT, URENCO MAY SUPPLY

Sao Paulo O ESTADO DE SAO PAULO in Portuguese 27 Aug 81 p 7

[Article by Paulo Andreoli: "United States Threatening To Suspend Uranium Shipments"]

[Text] The United States may suspend the shipment of new lots of 3-percent enriched uranium for the nuclear reactor of the Angra-1 power plant, purchased by Brazil from Westinghouse, an American outfit, scheduled to go into commercial operation in December. The United States government, according to confidential information from a reliable diplomatic source, would make the future supply of enriched uranium to be shipped to Brazil contingent upon the international safeguards instituted by the International Atomic Energy Agency primarily on what Brazil considers "national nuclear units."

In the meantime, however, according to disclosures made in Sao Paulo by a government source connected with nuclear matters, Brazil already has a contract with the European URENCO consortium (Holland, Great Britian, and Germany) for the supply of sufficient uranium to meet the country's needs in case the United States should not follow through on its commitments (see the article below).

The intention of the United States to suspend shipments, if Brazil does not accept the safeguards (the first lot of enriched uranium has already been delivered to Brazil) was expressed officially to Itamaraty [Brazilian Foreign Office] by American authorities last week. It is correct that United States Undersecretary for Inter-American Affairs Thomas Enders took up nuclear questions with Brazilian authorities and a summary of the results of his talks was sent via telex to the United States State Department, as was announced in Washington.

The thing that divides Brazil and the United States apparently involves only questions of a legal character regarding the obligatory nature of Brazil's commitment to submit its domestic nuclear power units to inspection by the International Atomic Energy Agency. According to the diplomatic source, the disagreements are serious and seem to be heading for even more serious political complications since neither the Brazilian authorities or the American authorities indicated that they were prepared to yield on their intentions.

Commitments

The Brazilian government seems to be prepared not to accept anything beyond what it has already promised to comply with. It has already promised to comply with the

explicit safeguards in the trilateral accord with the United States and with the International Atomic Energy Agency signed on 5 October 1972 ("Cooperation Agreement Relating to Civilian Uses of Atomic Energy between the IAEA, Brazil, and the United States, Concerning the Application of Safeguards," Decree No 71.207, replacing the earlier agreements, constituting the first agreement in Brazil relative to the purchase of a nuclear reactor for the commercial production of electric power, together with U-235 fuel).

The United States government believes that Brazil--by virtue of the commitments which it assumed in the trilateral accord--would be prepared to comply at least with the IAEA safeguard system, known formally as INFCIRC/66/II Rev (this is a circular report, known by this abbreviation, mentioned as such in the international agreements).

Exemption

International agreements on safeguards are generally concluded on the basis of the model of the agency's safeguard system, approved by the Board of Governors of the IAEA. INFCIRC/66/II Rev is divided into six parts, Professor Guido Soares, a specialist in nuclear law, recalled. Paragraph 31 of the circular establishes the rules as to exemption from safeguards: for up to 1 kilogram of special fissile material which is turned into 1 or more kilograms of (a) plutonium, (b) uranium enriched 20 percent or more, calculated through the multiplication of its weight with its enrichment, (c) uranium with enrichments below 20 percent, calculated by multiplying its weight five times with the square of its enrichment, (d) 10 metric tons of natural uranium and uranium reduced beyond 0.5 percent, and (e) 20 metric tons of thorium.

The Brazilian government already officially admitted that it has about 100 tons of natural (unenriched) uranium, partly in the form of yellow cake and partly in the form of uranium dioxide, pure in nuclear terms, processed at the IPEN (Nuclear and Energy Research Institute) in Sao Paulo. In this case, if the Brazilian government were to submit to the agency's safeguard system, it would have to provide satisfaction on this strategic material (where it is located, what the total volume is, changes in the volume, sale, exports, etc.). Brazil also has considerable stockpiles of thorium in excess of 20 tons; by submitting to the safeguards, it would have to satisfy the IAEA on that mineral. As for plutonium, Brazil does not have it--at least it is believed that it will have it only after the burning of enriched uranium in its nuclear reactors.

Debate

The United States government also argued that it feels that it is impossible to supply new shipments of enriched uranium to Brazil because domestic legislation prohibits that in connection with the Nuclear Energy Act of 1978. The Brazilian government in turn made it clear that, by virtue of the trilateral accord, Brazil would have to subject to international inspection the equipment, materials, and nuclear installations "transferred by the United States" and not the "national" equipment, materials, and installations, that is to say, those that were developed domestically and not purchased from the United States.

In the trilateral accord, Brazil and the United States agreed on preparing a complete inventory of what is being transferred. And only that material should be subjected to agency inspection.

This is why Brazilian authorities feel, according to the diplomatic source, that they do not have to submit to the safeguards. And they recall that Brazil did not sign the Nuclear Arms Nonproliferation Treaty of the IAEA, which is why it is not obligated to accept inspection of what it considers "national nuclear units."

The concept as to what "national nuclear units" are certainly will trigger a serious debate between the two countries. Without an understanding on that and other technical issues, the Angra-I nuclear power plant, which is already considerably behind schedule, runs the risk of winding up without any fuel for some time. It remains to be determined where and how Brazil is going to get that enriched uranium. We must not forget that, to ensure the supply of enriched uranium for the nuclear units acquired from Germany, Brazil will have to make a political effort abroad to frustrate the intention of the Dutch government which refused to supply enriched uranium to Brazil for the same reasons now alleged by the United States. (Germany, together with Great Britain and Holland, make up the URENCO consortium which produces enriched uranium for these three countries.)

It is true that, without a guarantee of enriched uranium supply, the reactor at Angra-I will not go into commercial operation. Its delay, so far caused by technical problems, might be extended further due to political problems. The diplomatic misunderstandings as a matter of fact are more political than legal; if the United States government were not interested in "pressuring" Brazil, the restrictions which now come up certainly could be gotten around. It so happens that, in addition to the legal arguments in support of the application of safeguards, the Americans can threaten with rather objective reprisals, such as cutting the supply of enriched uranium and, at least for some time, blocking the generation of nuclear energy in Brazil.

URENCO May Supply Angra-I

"Anticipating problems in the supply of enriched uranium from the United States, to supply the Angra-I nuclear power plant, the Brazilian government has contracted with the European URENCO consortium (Holland, Great Britain, and Germany) for shipments of uranium to meet Brazilian needs in case the Americans should fail to come through on their contract commitments," it was disclosed yesterday in Sao Paulo by a government source connected with nuclear questions. The same informant added that Brazil already has available the equivalent of 1,830 UTS (separation work units) and the option of having another 1,800 UTS, corresponding to the output of enriched uranium. These quantities are enough to meet the needs at Angra-I "for the entire period of its useful life."

The supply of American enriched uranium for Angra-I, according to that same source, is based on formal contracts signed between Brazil and the United States. The refusal to ship these supplies "will imply contract penalties, regardless of what the arguments are." The Brazilian government has begun to prepare itself for the possibility that the United States may stop shipments "ever since the Carter administration" and has tried to assemble "strategic stockpiles of enriched uranium by negotiating for supplies from URENCO for some time now."

The source also made it clear that it would be difficult for government authorities to admit the existence of "available strategic stockpiles" because that would place the German government in an unfavorable situation on the international scene, "forcing it into a clash with the Americans." This clarifying note, the source continued, is necessary to prevent the preoccupation that the Brazilian nuclear program might be interrupted as a result of the failure to obtain enriched uranium for the first Brazilian power plant "which in effect will not happen."

The first enriched uranium shipment, totalling 50 tons, has already been delivered to Brazil by the United States. It is stored, according to information obtained from Furnas Electric Power Plants, Inc, in the "fuel building" next to the Angra-I nuclear reactor. The first charge at Angra-I will be approximately 50 tons and each year about 15 tons will be "burned" in the reactor's core. At the end of 3 years however the entire charge will already have been replaced.

According to the press office at Furnas, Angra-I "is practically finished and can go into operation (tests with fuel) between 15 September and 15 October; this would not happen only because of the uncertainty regarding the next charges of enriched uranium." The source also confirmed that there are misunderstandings as to supplies from the United States.

IPEN and Safeguards

The irradiated uranium reprocessing unit of the IPEN, located at the University of Sao Paulo, is a national nuclear unit and therefore not subjected to international safeguards--or is it? Professor Hernani Amorim, director and superintendent of IPEN, feels that "the institute's irradiated material safety analysis laboratory, used for personnel training, is a domestic nuclear unit, that is to say, it was not procured in a ready-made fashion but was assembled with parts acquired from France, purchased and donated by Germany, and some were even manufactured in Brazil." He also noted that the assembly of this facility, by Brazilian engineers and scientists, was possible due to guidelines obtained in international literature on reprocessing units.

As for the unit's production capacity, Hernani Amorim prefers not to talk about that. He could not say whether the unit, for example, would be able to separate 1 kilogram of plutonium in a year. He asserted that "the plutonium separation capacity would seem to be proportional to the irradiated uranium which the reprocessing unit could supply. After completion and licensing by the National Nuclear Energy Commission, the laboratory would, under special conditions, have to separate a quantity larger than originally estimated for manpower training in irradiated uranium separation activity." The important thing, as far as the professor is concerned, is to realize that the IPEN unit was designed for testing the process and not for production.

5058
CSO:5100/2315

NUCLEAR WASTE SITES TO BE DETERMINED ONLY IN FIVE YEARS

Sao Paulo O ESTADO DE SAO PAULO in Portuguese 22 Aug 81 p 24

[Text] The areas of "sites" for Brazilian atomic waste disposal will be determined only within 5 years, after the completion of a geological mapping effort and other studies which are now being carried out by the country's research institutions. By then, in 1986, the Angra-I plant will have produced a considerable quantity of solid waste (clothing, shoes, equipment, and other materials to be discarded) plus 85 tons of irradiated (burned) nuclear fuel with high radioactivity.

The report as to the time for the selection of waste disposal areas was submitted yesterday in Angra dos Reis, in the State of Rio de Janeiro, by the director of the Nuclear Installations and Materials Department, CNEN (National Nuclear Energy Commission), Jose Julio Rosenthal. He added that studies aimed at this objective have already been going on for the past 5 years and that it will take a decade to complete them.

The solid, low-radioactivity waste, Rosenthal explained, will be processed and solidified initially in 180 drums of 200 liters, each, and will be stored in a pool built at the Angra-I power plant. The same storage process, according to the CNEN engineer, will be used with relation to gaseous waste, coming out after the reprocessing of the fuel burned by the reactor. But, since there is no reprocessing (the specific spot for that plant has not yet been selected although NUCLEBRAS [Brazilian Nuclear Corporations] announced that it will be ready in 1986), the burned fuel will be stored in the pool at Angra-I.

Time Required

The CNEN engineer displayed recent standards, issued in 1981 by the IAEA, permitting both waste and burned fuel to remain within the plant's pool "for the time necessary." He said that there was never any obstacle as to that aspect of the issue.

Rosenthal emphasized that "much work remains to be done" even after we pick the places for waste disposal. He maintained that many engineers--including others from the Earth Sciences Institute of the University of Sao Paulo, the Federal University of Rio de Janeiro, and the Mineral Resources Research Company--are involved in the most varied tasks. The entire effort is being carried out under the responsibility of the CNEN whose alternate site study groups perform an outstanding function.

The highly skilled human resources mobilized for this survey, the engineer said, will provide conditions for determining the disposal areas within the basic requirements of international standards.

5058
CSO:5100/2315

BRIEFS

FOREIGN FINANCING OF URANIUM PLANT--Brasilia. There are countries that are interested in financing a nuclear complex in Brazil through a guaranteed supply of Brazilian concentrated and enriched uranium, Mining and Energy Minister Cesar Cals disclosed yesterday. Questioned as to whether one of these countries might be Iraq, he confined himself to smiling, avoiding any admission or denial. He explained that these countries are interested in guaranteeing their supply with concentrated and enriched uranium from Brazil "by the middle of the decade of the nineties." Minister Cesar Cals defended the choice of Ceara as the ideal place for the nuclear complex, saying that "this is the most viable undertaking which we have at this moment in Brazil in terms of atomic energy because uranium is found there in association with phosphate and we could have an integrated project here which would help in promoting the economic viability of uranium mining." He also noted that the project will not be completely a state project because phosphate mining and phosphoric acid production, involving the raw material for phosphate-containing fertilizer, which would be handled by Petrofertil, already has produced various proposals from private enterprises based in Brazil. The portion involving mining and processing of uranium however would be controlled by NUCLEBRAS [Brazilian Nuclear Corporations] which has the monopoly. The study for the construction of the nuclear complex at Itatiaia is still in the Ministry of Mining and Energy and has been approved by NUCLEBRAS and Petrofertil, according to the minister. He expects to submit it to President Joao Figueiredo before the end of the year. [Text] [Rio de Janeiro JORNAL DO BRASIL in Portuguese 18 Aug 81 p 16] 5058

CSO:5100/2315

UNIVERSITY REACTOR FOR NUCLEAR RESEARCH TO BE INSTALLED

Port-of-Spain TRINIDAD GUARDIAN in English 20 Aug 81 p 5

[Text] Kingston Weds (CANA)--The Mona Campus here of the University of the West Indies (UWI) is to install a small nuclear reactor by the middle of next year, for use in research work in such areas as medicine, agriculture and geology, UWI Pro-Vice Chancellor, Prof. Gerald Lalor, has disclosed.

Prof Lalor, in a luncheon speech to Jamaican insurance underwriters, said the money for the reactor was being provided by the European Economic Community (EEC). He did not say how much it would cost.

"It will not be a reactor for energy or the generation of electricity or anything like that," Prof. Lalor said. "It is one for use as a research reactor in medicine and geology and what not."

Complete Survey

The university official said the first programme planned for the reactor was a complete survey of Jamaica's mineral potential.

It could serve, he said, as an accurate, high-speed analytical tool, and it was the university's intention to test several thousand geological samples, the results of which would be computerised and a contour map of mineral deposits plotted.

"It will give us a clear idea of what mineral potential there is," Prof. Lalor added.

He said such a survey would have immediate spinoff, with one benefit being the identification of areas with trace metals which could be of importance to agriculture.

Prof. Lalor said, too, UWI was actively looking into the possibility of using all forms of modern communication technology for a greater impact on education.

The university was convinced that the education system could not provide solutions to the region's problems working through conventional methods only.

CSO: 5100/7553

BRIEFS

MONITORING OF KOEBERG RADIATION--Yesterday, speaking in Capetown, Executive Committee Member Hernus Kriel, who is charged with local management, said that the Cape Province's City Council will be purchasing equipment for monitoring the danger of radio active radiation from Koeberg. In answer to a question raised in the Provincial Council he said that EVKOM [Electricity Supply Commission] had discussed the question of nuclear waste with Capetown health officials. Besides the National Advisory Committee, charged with nuclear safety, there are other committees which are also monitoring Koeberg. These committees consist of technical experts and representatives of local and provincial authorities. [Text] [Capetown DIE BURGER in Afrikaans 12 Aug 81 p 7] 7964

CSO: 5100/4956

BRIEFS

FIRM TO PROSPECT FOR URANIUM--More prospecting for uranium in the country is expected to start shortly when an agreement is concluded between Romania and Zambia, it was learnt in Lusaka yesterday. Romanian's new Charge d'Affairs to Zambia, Mr Gheorghe Lupes said experts from his country and their Zambian counterparts were still negotiating on the form that the agreement should take. He was answering questions on the progress of the negotiations at a Press conference he called on the eve of Romania's national day which falls on August 23. He said a Romanian firm, Geomin, was ready to start prospecting for uranium and other minerals as soon as the agreement was reached. He did not, however, indicate how long the negotiations would take. [Excerpt] [Lusaka DAILY MAIL in English 22 Aug 81 p 1]

CSO: 5100/4960

LONG-TERM MANAGEMENT OF RADIOACTIVE WASTES REVIEWED

Duesseldorf ATOMWIRTSCHAFT ATOMTECHNIK in English Aug-Sep 81 pp 493-498

/Article by J.M. Lavie: "The Long-Term Industrial Management of Radioactive Wastes in France"/

/Text/

1. The Need for a National Agency

Although the history of radioactive waste management is not different from that of the management of other wastes, its passage to the industrial scale has sparked several debates and controversies in recent years, both in political circles and in public opinion. This reaction may be paradoxical, since the relatively small quantity of wastes produced by nuclear power plants and the reliability of the available management techniques, in comparison with wastes generated by other sources of energy, should suffice by themselves to justify the choice of nuclear power to guarantee the satisfaction of energy needs and also those of the human environment. This can be shown by a few figures: France produces about 1 million tons of wastes of all types daily, whereas the cumulative volume of radioactive wastes generated by nuclear power plants up to the year 2000 will be less than 1 million cubic meters, including 2000 cubic meters of vitrified high activity wastes. Sewage purification alone produces 700 kg of sludges per capita each year, constituting a danger to the environment and costing vast sums to remove. These 700 kg of sludges per capita per year can be compared to one liter of radioactive wastes and to the few grams of vitrified wastes produced per year and per capita supplied exclusively with nuclear generated electricity.

However, the consequences of these debates, to which governments have committed their credibility which sometimes ceased to exist, and the acceptability of the industrial alternatives which are or which will be proposed, condition the indispensable growth of nuclear power.

These considerations, and the urgency of devising appropriate industrial solutions for removing these wastes, which form the final and vital industrial link in the development of the French nuclear power program, have induced the authorities to create an *Agence Nationale pour la Gestion des Déchets Radioactifs (ANDRA)*. In actual fact, the complete and indispensable control of all problems raised by long-term waste management could only be achieved

- within an industrial organization, owing to the scale of the market created by the vigor and scope of the French nuclear power program, with the commissioning of one power plant every two months and subsequent fuel reprocessing, the first effective link in waste management,
- within a public agency, a non-profit organization, in order to guarantee the stringent application of safety requirements, permanent long term responsibility, at a fair cost,
- on the national level, to ensure the necessary cooperation between the different organizations concerned in the development of industrial solutions.

2. The National Agency for Radioactive Waste Management (ANDRA)

Formed within the *CEA* by an interministerial order dated 7 November 1979, within the framework of legislative and regulatory provisions already in force, ANDRA is responsible for industrial operations related to long term radioactive waste management, and in particular with:
- the development, siting and construction of new long term storage centers, and the performance of all investigations required for this purpose, especially with respect to production,
- the management of long term storage centers, either directly or through the intermediary of third parties acting on its behalf,
- the establishement, in collaboration with waste producers, of radioactive wastes packaging and storage specifications, prior to their removal to the long term storage centers (this is the link between upstream management and downstream management),
- contribution to research, development and operations concerned with long term radioactive waste management processes as well as future developments.

The organizations that have been set up reflect the determination of the authorities (fig. 1):
- to see the latest developments of science and technology applied to radioactive waste management, this is the role of ANDRA's Scientific and Technical Council, presided by the Chairman of the Atomic Energy Commission,
- to associate leading personalities and the different organisms generating the wastes in the waste management programs; this is the purpose of ANDRA's Management Committee, presided by the Chairman of the Board of the CEA.

The creation of ANDRA also reflects the decision of the authorities to make a clear separation between monitoring and regulation activities and those related to industrial operations. It marks the industrial maturity of long term waste management. ANDRA takes charge of recommending policies and industrial disposal alternatives, and the safety authorities are responsible for giving their opinion to the supervisory authority that decides on the matter.

A storage center is a fully-fledged industrial installation, and has since 1963 been considered as a Basic Nuclear Facility. Its nuclear operator, ANDRA, which cannot delegate its responsibilities, is subject to regulations governing the Basic Nuclear

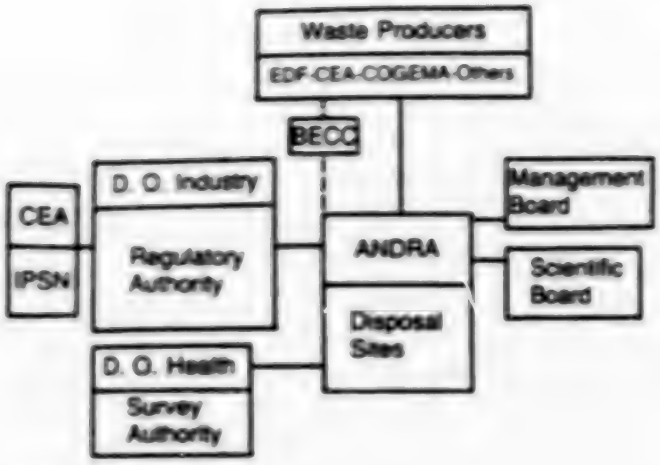

Figure 1 · Organisation Chart.

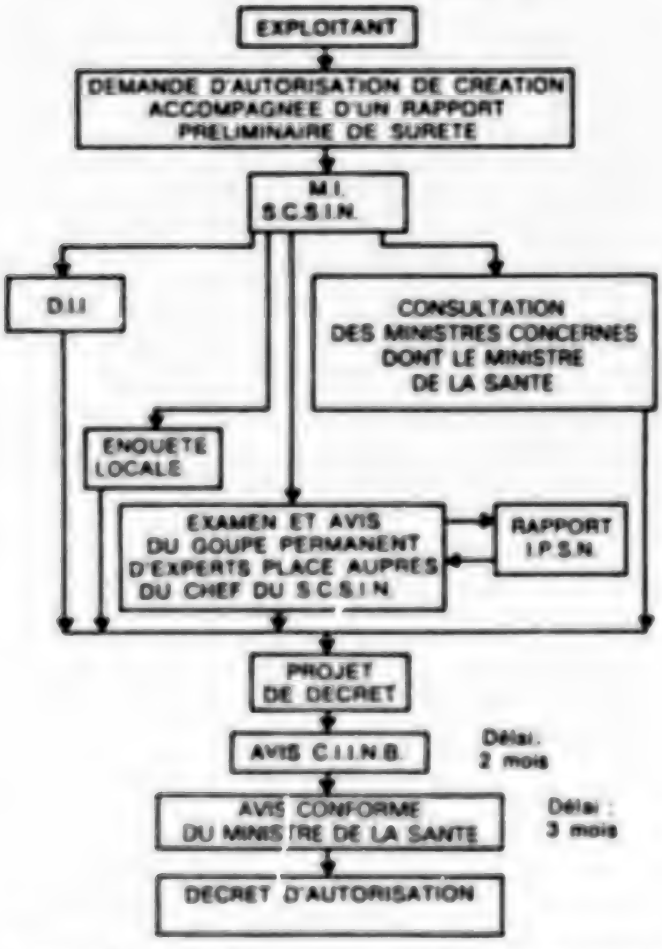

Figure 2: Scheme of the Procedure Related to Creation Authorization of Basic Nuclear Facilities.

Facilities (fig.2) both for the licensing procedure for the creation of a new storage center, or controls of the existing center, by the SCSIN (Service Central de Sûreté des Installations Nucléaires) for safety aspects and by the SCPRI (Service Central de Protection contre les Rayonnements Ionisants) to check the absence of impact on environment.

ANDRA is a light organization whose activity is centered on a high-level management role for the achievement of optimization on the economic and safety levels. ANDRA employs about 20 peoples, including 15 management staff (fig. 3).

3. The Need for an Overall Industrial Approach

It appeared very early, as soon as the nuclear power programs were launched, that the cost of waste disposal in the strict sense of the term was only a fraction of about 10 to 20% of the total cost of the waste management system (treatment + conditioning + disposal), and that this cost was directly related to the disposal concept implemented. Hence the need to determine the disposal concepts in advance, in order to design up-stream management (treatment + conditioning) more efficiently and more economically especially in the reprocessing facilities and nuclear power.

The optimization of waste management as a whole, from the economic and safety standpoints, thus requires its industrial approach to be consistent and therefore all-encompassing, concerned at once and with equal urgency with the concepts and identification of storage centers as well as waste treatment and packaging. This requires anticipation. It is vain to try to improve treatment and conditioning techniques without first determining the concepts and typical characteristics of the storage center. ANDRA's industrial approach is part of a consistent policy of optimized integration of all the different factors involved in waste management in the broad sense of the term, from their initial source, all the way to the final storage center. This is achieved by cooperation between Producers and ANDRA, as desired by the authorities.

4. Industrial Management Concepts

The problems raised by long term radioactive waste management are essentially no different from those raised by the management of all other wastes, with two significant advantages for radioactive wastes, apart from their small volume, their radioactive decay and the reference to natural radioactivity that many toxic chemical wastes that are complete newcomers to the earth lack.

The basic rules governing long term waste management are to protect mankind today and tomorrow, to preserve his environment and his resources, and to minimize the burden on future generations. This means:

- on the prevention level: the limitation of waste production to the strict minimum, by sorting and by a possible volume reduction.

- on the protection level: the insertion of barriers between the environment and these wastes, to guarantee their confinement throughout the time required for their radioactivity to decay.

These universal principles having been stated, it remains to implement them on the industrial level, and this depends on the art of management, namely, the skill of the manager. In this respect, as for any other industrial product, it is important:

- to inventory and identify the needs, namely, the industrial market and this is the purpose of waste production and delivery forecasts, which cover not only the volumes but also the characteristics, as well as disposal deadlines,
- to define the disposal concepts which are both accessible

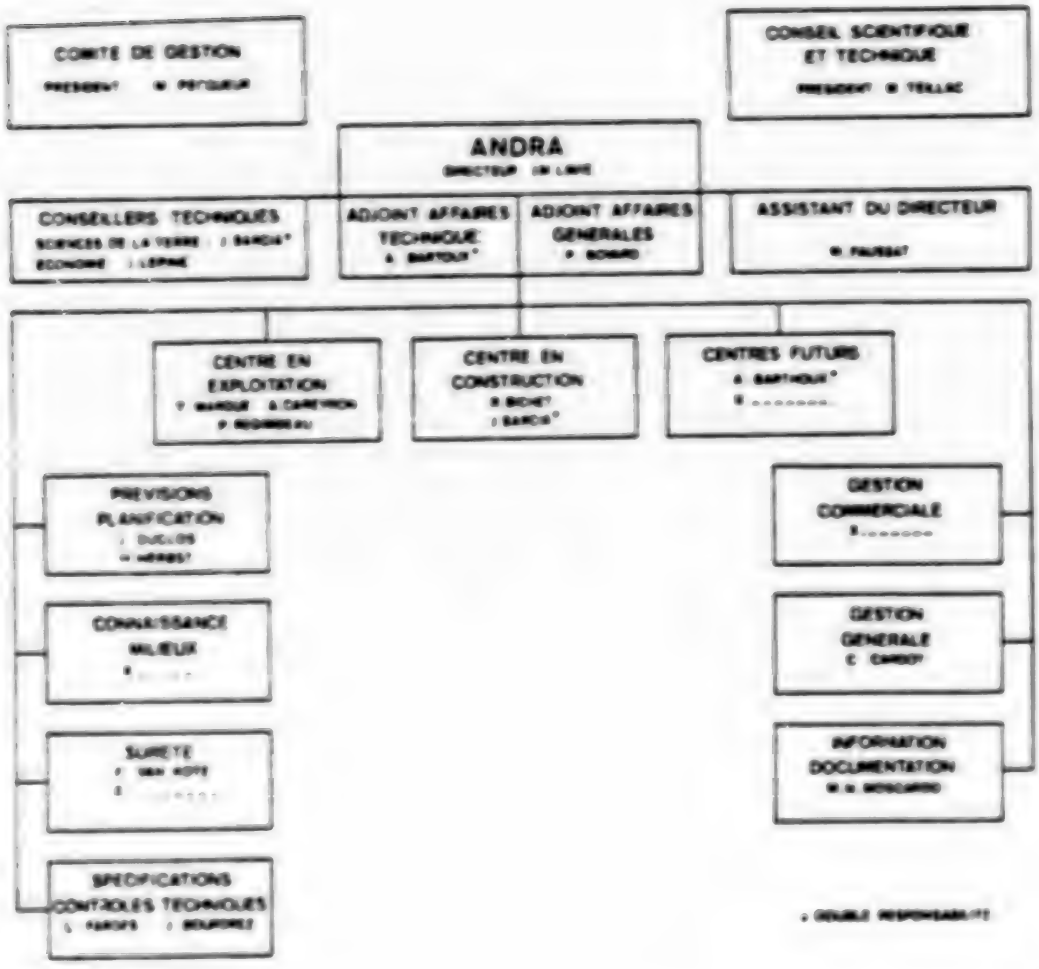

Figure 3. Responsibilities.

technologically, reasonable from the economic standpoint, and satisfactory from the safety and environmental standpoints, but also and above all, sufficiently simple and clear to be understood easily by public opinion. This definition of concept must try to optimize and minimize the radioactive exposure of workers and also the populations of today and tomorrow;

- to select predetermined sites, or at least possible types of sites, meeting the selection criteria deriving from the disposal concepts adopted for the establishment of the long-term storage center. This choice is the bottleneck in the disposal of radioactive wastes, and not their volume.

Once this prospective approach has been made and accepted by the safety authorities, the supervisory authorities and, if possible, the majority of the public, together with the waste producers themselves, it becomes possible to define the following in a consistent, optimized manner:

- the technical specifications that must be met by the conditioning and packing of the different waste categories, preparatory to their being taken over by ANDRA for disposal in long-term storage centers. Each type of package will be covered by a procedure for securing authorization from ANDRA. In addition to the characteristics of the package and the source of the wastes contained, the authorization file will include the process book relating to its preparation;
- quality assurance controls that ANDRA has or will have performed to guarantee the compliance of the package to the authorization file, requiring the availability of testing and inspection facilities.

Furthermore, this prospective approach will lead to a research and development plan applied to long-term waste management of which it is important to ensure that the objectives and deadlines are adequately covered by national or multinational programs financed by resources other than those of ANDRA, or other credits must be secured and other research and development facilities set up?

Now that these universally applicable concepts have been summarized briefly, let us examine the scope of the market, namely, ANDRA's work program, and then go on to France's policy in meeting the needs expressed.

5. ANDRA's Work Plan

With respect to the long-term management and design of final storage centers, radioactive wastes can be classified in three major categories as a first approximative:

- Wastes containing short half live radioelements, less than 30 years (essentially beta and gamma emitters), of which the long half-life radioelement concentration (essentially alpha emitters) is lower than the limits set for the site in question by the safety authorities. These wastes, commonly referred to as "low and medium activity wastes".

- Wastes containing a significant amount of long half-life radioelements (over 30 years) with high potential harmfulness. In practice, and to simplify the terminology, this category corresponds to wastes containing alpha emitters often called "alpha wastes". The alpha emitter concentration is considered as significant if it is higher than a concentration limit set by the safety authorities for each storage site.
- Fission products produced by reprocessing, and current vitrified. The glasses thus formed have a high specific activity and consequently liberate a considerable amount of heat.

Figure 4 **Forecast of Waste Deliveries (m^3)**

	1990 annual	1990 cumulated	1995 annual	1995 cumulated	2000 annual	2000 cumulated
LMA	20 000	20 000	50 000	500 000	65 000	650 000
Alpha	270	270	2 000	9 000	3 000	35 000
Glasses	0	0	380	380	175	650
					190	1 650

It may be noted that while it is important to take account of the criterion of the external irradiation of the packages for the organization of transport and handling during the operating period, this does not play primordial role with respect to this classification related to the choice of the storage method.

It should be stressed that very high activity wastes are distinguished by very small volumes, and that long half-life wastes display very low radioactivity.

Forecasts of waste deliveries to ANDRA for disposal constitute the very sense of any consistent storage policy. An outstanding effort has been made at all levels to improve the reliability and accuracy of medium and long-term forecasts. Obviously, simplifying assumptions have been made. Permanent updating will be necessary as operating experience grows.

Fig. 4 gives the annual and cumulative delivery forecasts corresponding to a few key dates for each of the three waste categories.

From the clientele standpoint, apart from some 10 large clients, ANDRA has more than about 3000 small clients designated by the name of third parties, including hospitals, universities, research laboratories and industry.

6. French Long-Term Industrial Management Policy and Planned Facilities

From the practical and industrial standpoint, after possible waste treatment, the wastes are usually neutralized and then encased in a matrix (cement, bitumen, resins ...) or vitrified.

and finally packaged in a container for disposal. In actual fact, for many reasons and especially in order to meet transport safety regulations, and facilitate their handling, packaged wastes are presented in the form of highly elaborate packages. They now have to be stored finally.

French disposal policy as many others foreign policies is based on the consideration of four principal factors:

- the advantage of radioactive decay,
- the risk of human intervention or the action of water,
- the duration of the effectiveness of artificial barriers,
- the total cost of waste disposal.

The optimization of these four factors leads to (fig. 5):

- sub-surface storage of short lived wastes or non-alpha wastes, because we have barriers with an effectiveness of at least 300 years, and surveillance of the storage site throughout this period;
- deep storage of long lived wastes or alpha wastes at a suitable depth to shield them from unforeseen human intervention. Hence only the action of water needs to be considered;
- deep storage of vitrified wastes after a prior cooling period on the surface or in situ.

The final storage of low and medium activity wastes, the only wastes whose final storage can be authorized in France for the time being, is carried out by sub-surface storage in accordance with the following basic principle:

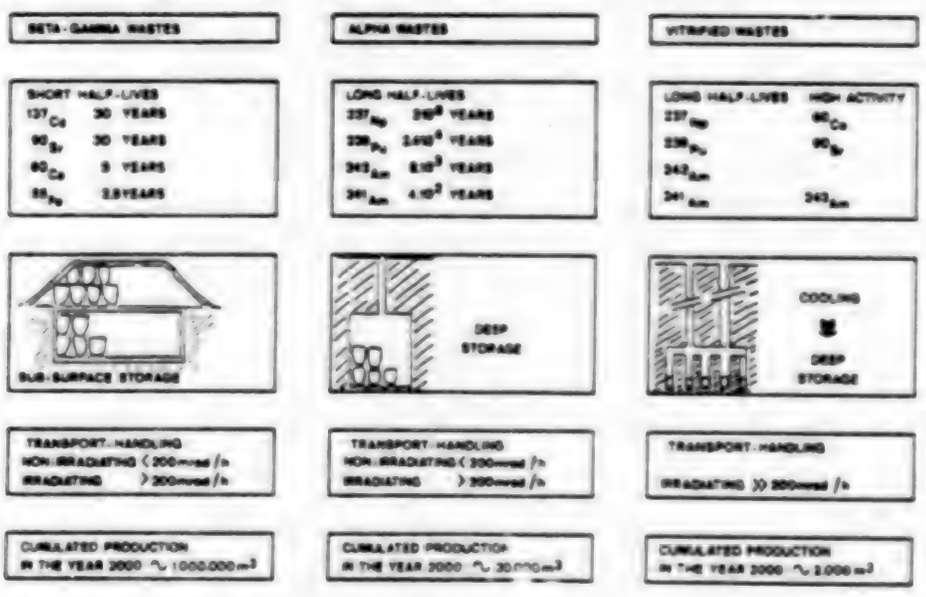

Figure 5: Waste Classification.

The confinement of radioactive materials, and hence their isolation from the present or future human environment, must be guaranteed for a sufficiently long time (200 to 300 years) to give them the time to decay to a level at which the potential risk that can be considered to be negligible.

This serves to distinguish three in the life of such a storage center:

- the *operating* period during which the wastes are installed in place and the insulation structures built. This period may last 10 to 25 years;
- the *surveillance* period after operation, during which no works need to be performed other than possible repair operations, but during which surveillance is provided. The site remains the property of the State and access is restricted. This period may last 200 to 300 years;
- the *unrestricted access period*, during which no surveillance or service is provided, and in which access or enjoyment of the site may be decontrolled. The only remaining risk would be that of the dispersion of long half-life materials, in the event that a limit had not been set for the wastes accepted by such a storage center. This limit must be set in terms of both maximum concentration per unit volume and total activity storable in the center.

From the practical standpoint, in view of progress achieved in waste packaging techniques, and the quality of these packages, it is possible, by special arrangements on the storage center (concrete monolith, sealed cover, water drainage, etc.), to achieve sufficient isolation of the wastes industrially with artificial barriers (fig. 6).

This makes it possible to be less stringent with respect to the intrinsic qualities of a surface storage site, especially since, whatever these may be, no savings could be realized, since their acceptance by public opinion will in any event demand the long-term reliability of artificial confinement.

However, the real characteristics of the site selected are nevertheless determined and taken into account to make sure that:

- during the operating and surveillance phases after operation, the risk level in case of incident remains lower than the maximum level allowed by national and international regulations,
- during the unrestricted access period, potential risk levels remain negligible in any eventuality.

It is on the basis of the foregoing considerations and after having made a thorough safety analysis that the waste acceptability rules are set. Experience hitherto gained shows that the acceptability rules thus determined serve or will serve to accomodate the bulk of the "beta and gamma wastes" of which production can be foreseen in France.

For this purpose, ANDRA has the *Manche Storage Center (CSM)* with an area of about 30 acres, a surface storage capacity of about 300,000 m^3 of low and medium activity wastes, of which about 120,000 m^3 are already occupied. At the growing delivery rate of 20,000 m^3 per year, the CSM will be saturated in 1985–1986, although it would seem wise to reserve the remaining capacity to accommodate wastes from

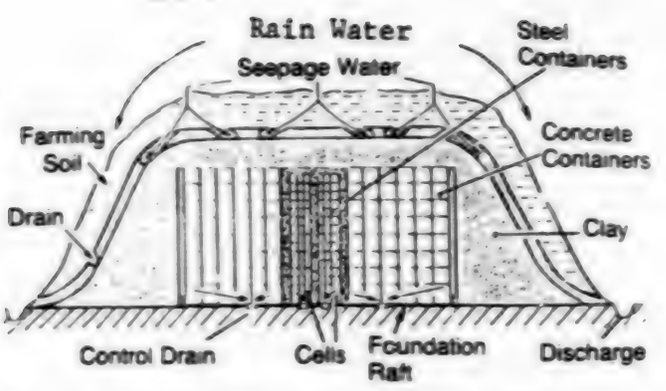

Figure 6: Principle of Storage: Platforms and Drains.

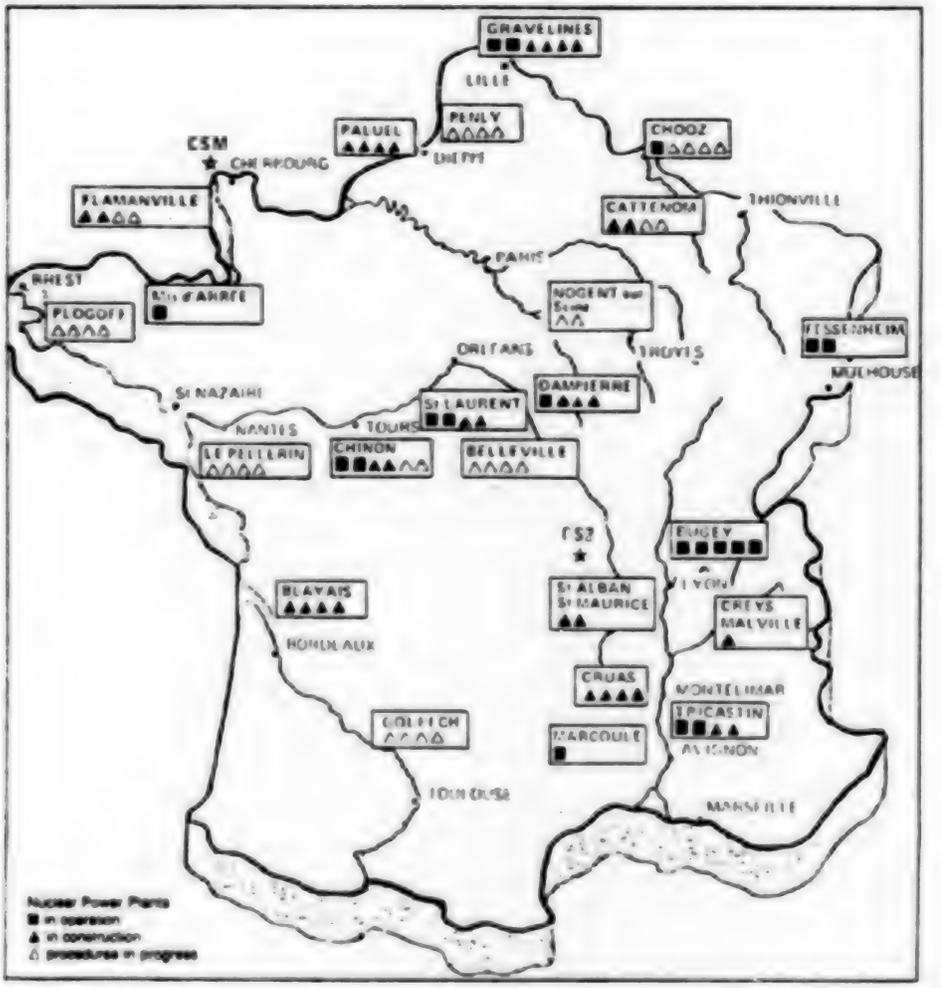

Figure 7: Nuclear Reactors in Operation, under Construction and Planned (September 1, 1980).

the adjacent Cogéma facility and neighbouring nuclear power plants. The creation of a second storage center for low and medium activity wastes, capable of accommodating several hundred thousand cubic meters, is therefore necessary in the very short term, if possible in central for southeastern France (fig. 7).

This is why, simultaneous with the formation of ANDRA, the government decided to establish a second storage center. The *Bois Noirs* site in the Forez region was selected and the plan was made public in autumn 1979. The licensing request for the creation of this center was filed on March 30, 1980. Subject to the granting of this authorization, inauguration is planned for early 1983. The local inquiry, opened on May 19, 1980, was closed without any significant incident on June 13. This center will only accommodate low and medium activity wastes for final storage.

This second storage center will have capacity of a few hundred thousand m^3 of surface storage. Subject to thorough geological and hydrogeological surveys, this capacity could possibly be expanded considerably by the digging of tunnels. If these surveys, which will be carried out in 1981, yield positive conclusions, ANDRA will file a new authorization request.

Alpha wastes, namely those whose long half-life radioelements preclude final surface storage, will be stored at medium depth in France.

The objectives of ANDRA's industrial policy governing alpha waste management are:

- to attempt to build a long-term underground disposal facility, in tunels dug in the second storage center or on another site (CS. 3) ANDRA will implement the investigative means to try to secure the qualification of this alpha center and its industrial commissioning before 1990;
- to organize temporary storage facilities to meet the most pressing needs.

As for *vitrified wastes*, the solidification solution selected by France and many countries committed to nuclear power, they are temporarily stored on the surface on the production sites. ANDRA is actively investigating the most suitable method of disposal, both from the safety and economic standpoints, in the ideal geological formation and at a suitable depth, on a land site.

This activity per unit volume of the fission products vitrified wastes is very high. Consequently, the heat energy produced by the packages is so high that, in the initial years following their production, it is impossible to bury them without special precautions, because the degradation of these packages and the environment could incur unacceptable risks.

Different solutions have been proposed to solve this problem:

- cool the packages completely on the surface for about 150 years and then bury them so as to consider them as merely cold packages, making it possible to have a compact storage unit.
- cool them partly on the surface, for example for 30 years and bury them. In this case, the residual heat remains high, and a large storage facility must be built, with the packages sufficiently distant from each other to prevent average heating from being prohibitive.

- build a compact geological storage facility a few years after the fabrication of the glasses, cool the packages in situ, and after a sufficient number of years, transform this storage facility into a disposal by sealing it suitably.

These three solutions are currently being investigated by ANDRA, particularly the third, in the following steps:

- feasibility study initially aimed essentially at the analysis of heat problems and at mining problems,
- if this study is conclusive, the creation of a demonstration glass storage facility (SDV) which could be designed to make a full-scale demonstration of a very long-term storage facility.

This SDV, or a surface storage center, should enter service in 1992, when Cogéma will deliver the first glasses to ANDRA (about 400 m^3); the total volume of foreseeable deliveries by the year 2000 will reach a maximum of 2000 m^3.

Simultaneous with the feasibility study, or at least as soon as the study has shown that the hypothesis of cooled storage in situ is not discarded, ANDRA will carry out a census and assessment of a number of sites in France, those which could accommodate the demonstration storage facility when the time comes, and later, the industrial storage facility. This study will naturally be carried out jointly with the prospecting of sites for low heat emission alpha wastes.

7. The Financing of ANDRA's Activities

Like for the disposal of other wastes, the "polluter pay" principle is applied to the financing of ANDRA. This is secured as follows by the waste producers:

- annual operating costs of the storage centers and of ANDRA are directly billed to the organizations that deliver the wastes,
- specific investments, namely those related to the storage of specific wastes, from clearly identified owners, are prepayed by the latter,
- finally, the remaining and most investments, called joint investments, are financed by loans, for which the service is covered annually by the organization that produced the wastes under hand contracts.

As for the long-term burdens, the distribution principle has been selected, similar to the retirement system, in which the young wastes pay for the old wastes, in preference to capitalization. However, a provision to cope with immediate expenditures in case of accident is gradually being installed.

As an order of magnitude, the five year plan, provides for expenditures in the order of 700 MF including 400 MF of capital expenditures over the 1980–1984 period. In exchange for its monopoly, ANDRA guarantees its clients the correspondence of its management, the chief among these clients being members of its executive committee.

8. The Policy of Operating, Engineering and R&D Assistance

The ANDRA's creation act clearly states that ANDRA can not delegate or transfer its liabilities in other words, ANDRA must remain the owner and prime contractor. But, for reasons of flexibility, a lightweight organization was adopted for ANDRA which therefore relies on operating, engineering and research and development assistance.

ANDRA, the owner and prime operator of CSM entrusts under its supervision, the management of the CSM to an operator.

For engineering, ANDRA calls on the services of different industrial consulting engineers.

Furthermore, for the R&D standpoints, ANDRA relies on the operational units of the CEA and on the services of different organizations engaged in this field.

9. Conclusion

I would like to emphasize, after this outline of the frame work of industrial waste management policy in France, that the most important problem met by ANDRA remains the political and social problem. ANDRA is to convince the public that the establishement of these industrial facilities serves and will serve to solve the problem of radiactive waste disposal in condition of safety substantially equivalent to those governing the disposal of all other waste.

CSO: 5100/2317

BRIEFS

EIGHT FAST SHUTDOWNS IN QUARTER--Nuclear plants in Sweden experienced eight fast shutdowns during the first quarter of this year. This appears from the quarterly report of the Nuclear Inspection Agency (SKI). The period was characterized by a normal operation for most of the units, said SKI. Five of the fast shutdowns hit Forsmark 1. Three of these were caused by problems in the turbine parts. Ringhals 1 ran best. It was in operation the entire period without any problems or fast shutdowns. The plant has thereby set a record: Ringhals 1 delivered electricity to the power network for 174 days in a row. [Stockholm SVENSKA DAGBLADET in Swedish 18 Aug 81 p 7]

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18 Sept 1981